

GCSE Chemistry (9 – 1)

Mole calculations - Harder

Name:

Group:

Instructions

- Read each question carefully before you begin to answer it.
- Use black ink or black ball-point pen for your answers.
- Fill in the boxes at the top of this page with your name and group.
- Attempt to answer every question in the booklet.
- Answer the questions in the spaces provided – there may be more space than you need in some answer spaces.
- Calculators may be used for this booklet.
- For any calculations, you **must** show all your working.
- Any and all drawings or graphs should be completed in pencil.



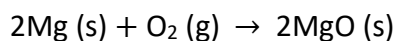
For markers use	
Question	Mark
1	/5
2	/3
3	/3
4	/3
5	/8
6	/3
7	/3
8	/4
9	/3
10	/3
11	/5
12	/7
Total	/50
%	
Grade	

Information

- The maximum mark for this paper is 50 marks.
- The marks for each question are shown in brackets.
- Please be aware that good English and clear presentation are required in your answers.



1. Magnesium reacts with oxygen gas. Magnesium oxide is formed from this reaction.
The balanced equation for this reaction is:



- a. Calculate how much magnesium is needed to make 20 g of magnesium oxide?
Circle the letter of the correct answer.

A

10 g

B

12 g

C

14 g

D

20 g

(1 mark)

- b. How many moles are present in 26.88 g of SO_2 . Circle the letter of the correct answer.

A

0.42 mol

B

0.40 mol

C

0.75 mol

D

0.48 mol

(1 mark)

- c. One mole of oxygen gas, $\text{O}_2 \text{ (g)}$, occupies a volume of 24 dm^3 .
What volume does 8 g of $\text{O}_2 \text{ (g)}$ occupy? Circle the letter of the correct answer.

A

2 dm^3

B

4 dm^3

C

6 dm^3

D

8 dm^3

(1 mark)

- d. How many atoms are present in 0.75 mols of water?
Take Avogadro's constant as 6.02×10^{23} . Circle the letter of the correct answer.

A

2.0×10^{23}

B

4.5×10^{23}

C

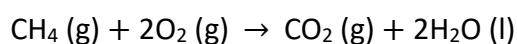
1.35×10^{24}

D

4.5×10^{24}

(1 mark)

- e. Methane burns in oxygen to form carbon dioxide and water.
The balanced equation for the reaction is shown below:



What mass of oxygen is needed to fully combust 18 g of methane? Circle the letter of the correct answer.

A

48 g

B

36 g

C

60 g

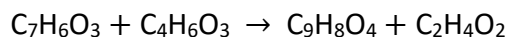
D

72 g

(1 mark)

(Total for Question 1 is 5 marks)

2. Salicylic acid ($C_7H_6O_3$) and ethanoic anhydride ($C_4H_6O_3$) are reacted together to produce aspirin ($C_9H_8O_4$) and ethanoic acid ($C_2H_4O_2$). The equation for the reaction is:



What mass of salicylic acid, $C_7H_6O_3$, is needed to produce 1.32 g of aspirin?

.....

.....

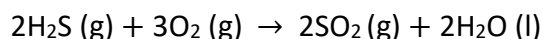
.....

.....

(3 marks)

(Total for Question 2 is 3 marks)

3. A student is doing an experiment reacting hydrogen sulfide with oxygen gas. The equation for the reaction is shown below.



What mass of oxygen is needed to react with 42.5 g of hydrogen sulfide (H_2S)?

.....

.....

.....

.....

(3 marks)

(Total for Question 3 is 3 marks)

4. Calcium carbonate can be thermally decomposed to make calcium oxide and carbon dioxide. The equation for the reaction is:



Determine the mass of calcium carbonate needed to make 418 g of calcium oxide. Give your answer to 3 significant figures.

.....

.....

.....

.....

(3 marks)

(Total for Question 4 is 3 marks)

5. Hydrogen sulphide, H_2S , burns in oxygen, O_2 , to form sulfur dioxide, SO_2 , and water.

a. Write the **balanced symbol** equation for this reaction.

.....
(3 marks)

b. A student did the reaction in such a way that the hydrogen sulphide is the limiting reactant.
Explain what is meant by the term limiting reactant.

.....
.....
(1 mark)

c. What effect does a limiting reactant have on a reaction?

.....
.....
(1 mark)

d. Calculate the mass of sulfur dioxide made from 102.3 g of hydrogen sulfide.
Give your answer to 3 significant figures.

.....
.....
.....
.....

Mass of sulfur dioxide = ... g
(3 marks)

(Total for Question 5 is 8 marks)

6. The formula of copper ethanoate is $\text{Cu}(\text{CH}_3\text{COO})_2$.

Calculate the number of atoms that combine together to form 6.5 g of copper ethanoate.

Take Avogadro's constant as 6.02×10^{23}

.....
.....
.....

Number of atoms = ... g
(3 marks)

(Total for Question 6 is 3 marks)

7. Compounds that contain the element iron, Fe, have many uses.
Calculate the mass of **one atom** of iron. Take Avogadro's constant as 6.02×10^{23}
Give your answer to 3 significant figures.

.....

.....

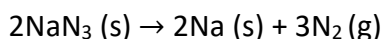
.....

.....

Number of atoms = ... g
(3 marks)

(Total for Question 7 is 3 marks)

8. One of the ways that nitrogen gas can be obtained is through the decomposition of sodium azide, NaN_3 . The equation for the reaction is:



Calculate the maximum volume, in cm^3 , of nitrogen gas produced from 50 g of sodium azide.
1 mol of gas occupies 24 dm^3 . Give your answer to 2 decimal places.

.....

.....

.....

.....

Volume = ... dm^3
(4 marks)

(Total for Question 8 is 4 marks)

9. A student was doing an electrolysis practical where 120 mg of zinc was formed at the cathode.
Calculate the number of zinc atoms in 120 mg of zinc.
Take Avogadro's constant as 6.02×10^{23}

.....

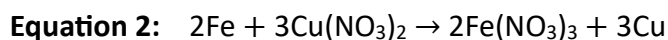
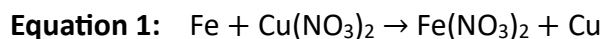
.....

.....

Number of atoms = ... g
(3 marks)

(Total for Question 9 is 3 marks)

10. Copper can be extracted from its compounds using iron as iron is more reactive than copper.
A student did an experiment where they reacted iron with copper nitrate solution.
The student wrote a balanced equation for the reaction but was unsure about it as there were two different equations that could be correct. Two possible balanced equations for the reaction are:



The student found that 4.48 g of iron reacted with excess copper nitrate solution to form 7.62 g of copper.

Using calculations and the masses above, show which equation represents the reaction taking place.

.....

.....

.....

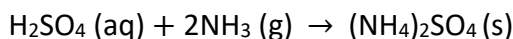
.....

.....

(3 marks)

(Total for Question 10 is 3 marks)

11. Ammonium sulphate is regularly used as a fertiliser. Ammonium sulphate is made from the reaction of sulphuric acid and ammonia. The equation for the reaction is shown below.



- a. What is the maximum mass of ammonium sulphate that can be made from 2.50 kg of sulfuric acid and 1.50 kg of ammonia?

.....

.....

.....

.....

(3 marks)

- b. State and explain which reactant is the limiting reactant.

.....

.....

.....

(2 marks)

(Total for Question 11 is 5 marks)

12. Lead is most commonly extracted from its ore, lead sulfide, PbS. This ore can be found in various mineral deposits in the soil. Lead sulfide is typically smelted with carbon to extract the lead but it can also be extracted via reactions with acids.

A student does an experiment and reacts solid lead sulfide with nitric acid, HNO₃.

Lead nitrate, Pb(NO₃)₂, nitrogen oxide, NO, water, H₂O and sulfur, S are made.

- a. Write a balanced symbol equation for this reaction.

.....
(2 marks)

- b. What mass of lead nitrate would be produced if 48 g of lead sulfide reacts completely with nitric acid? Give your answer to 3 significant figures.

.....
(2 marks)

- c. In another experiment the student reacted 64 g of lead sulfide with 80 g of nitric acid. The equation of this reaction is:



Which reactant is the limiting reactant and, using calculations, give a reason for your answer.

.....
(3 marks)

(Total for Question 12 is 7 marks)